

REPORT

FROM

THE SECRETARY OF WAR,

In compliance with a resolution of the Senate relative to the application of a mineral solution to the preservation of timber, called "Kyanizing."

APRIL 9, 1840.

Ordered to be printed.

APRIL 10, 1840.

Referred to the Committee on Naval Affairs.

APRIL 21, 1840.

Committee discharged, and 200 additional copies ordered to be printed.

WAR DEPARTMENT, *April 9, 1840.*

SIR: I have the honor to submit the reports of the chiefs of the Engineer and Topographical Bureaus, furnishing the information called for by a resolution of the Senate, dated the 20th ultimo, relative to the application of a mineral solution to the preservation of timber, called "Kyanizing."

Very respectfully, your most obedient servant,

J. R. POINSETT.

Hon. R. M. JOHNSON,

President of the Senate.

BUREAU OF TOPOGRAPHICAL ENGINEERS,

Washington, April 3, 1840.

SIR: In reference to the resolution of the Senate of the 20th instant, I have the honor to submit the following report:

Kyanizing is the name for a process of saturating timber with a solution of corrosive sublimate. The name is derived from the inventor (J. H. Kyan, Esq., of England), who, having ascertained, by a great variety of experiments, "that albumen was the primary cause of the putrefaction and subsequently of the decomposition of vegetable matter," and aware of the affinity between albumen and corrosive sublimate, he concluded that, by saturating timber with the corrosive sublimate, its combination with the albumen would prevent its fermentation and decomposition, and consequently their destructive effects upon the timber. The object of the process is, therefore, to combine a well-established anti-destructive material with that which is considered the principal cause of the destruction of timber, and

thus to modify the character of the latter by the formation of a new and comparatively indestructible compound.

Mr. Kyan justly deserves the credit of the invention in its useful application, and which, it would seem, has generally been conceded to him by the name of the process, although the use of corrosive sublimate, as a preventive of dry-rot, was suggested in the form of a wash by Sir Humphrey Davy; and Chapman, "on the preservation of timber," as stated in Thompson's Chemistry, says, "corrosive sublimate may be advantageously used in the proportion of one ounce to one gallon of water, to be applied hot."

The mode of operation is, to construct a trough, or tank, in which the timber intended to be prepared is placed, and secured in position, when the trough, or tank, is sufficiently filled with the solution to cover the timber thoroughly.

The cost of preparing the timber depends upon the following elements; first, the construction of the tank; 2d, the cost of the corrosive sublimate; 3d, the proportion of the mixture and quantity absorbed; and 4th, the labor of attending the process.

The cost of the tank would be to be divided upon the whole quantity of timber prepared, and would, of course, lessen the expense of preparing the timber in proportion to the quantity. The cost of the corrosive sublimate is about per pound; the proportion to water is variously stated at one pound to five gallons of water, one pound to seven gallons, and one pound to fifteen gallons: this last is considered as the weakest admissible solution. The quantity absorbed must depend upon the kind of timber. The more albuminous matter it contains, the more of the solution will have to be absorbed to produce the desired change of that matter. The labor in attending upon the process is not great. In an experiment made in the navy yard at Boston, in 1838, the labor was estimated at about one-ninth of the whole expense; the proportions of the mixture, one pound of corrosive sublimate to seven gallons of water; and the cost of preparing the timber, exclusive of the cost of the tanks, at about twelve cents the cubic foot. I have understood that some interesting experiments were made by Colonel Totten, of the corps of engineers, when stationed at Fort Adams, which will, no doubt, be noticed in his report under the resolution.

Kyan says, that a load of pine timber (fifty cubic feet) will cost, to preserve it, twenty shillings sterling—about ten cents per cubic foot; and that this quantity would require about one pound of corrosive sublimate. In the United Service Journal, the quantity is stated at from one to one and a half pounds the load. In an article in the Journal of the Franklin Institute, from the Earl of Manvers, the proportion of one pound to ten gallons of water is given.

Mr. G. M. Totten, civil engineer, in an estimate of the cost (Army and Navy Chronicle, for 1837, page 341), at one pound to five gallons of water, or, according to others, at one pound to ten gallons, assumes, that a cubic foot of oak timber will absorb three pints of the liquid; and he states the price of the corrosive sublimate at eighty-six cents the pound, the cost of the liquid, at six and a half cents per cubic foot, that of tanks, labor, and liquid at eight cents; but he does not appear to have made any allowance for labor in attending to the process, or other contingency.

Corrosive sublimate is soluble in water at the rate of five parts by weight, to one hundred parts by weight, of water at 60° of Fahrenheit, or eight

ounces per gallon ; and fifty parts in one hundred, at a temperature of 212° of Fahrenheit, or five pounds per gallon. From which it will be observed, that the strength of the mixture depends upon the temperature of the water used, and no doubt also upon its softness.

I have, myself, made no experiments on this matter. The remarks which occasioned the resolution are in the last annual report from this office, in which the use of Kyanized timber is recommended for the harbor improvements on the lakes, and with the object of giving to those improvements a character of greater permanency than can be obtained to an equal degree in any other way, at so small an expense. In case these improvements should be continued, the preparing of the timber will open a field for the most interesting experiments, and upon a large scale.

Of the main point involved, namely, that Kyanizing timber really increases its durability, there is, I believe, now no doubt. Upon this single point, therefore, there need be no experiment. It is, I think, sufficiently established, as may be ascertained, in addition to the authorities already referred to, from Professor Farrady's lecture of 1834, a pamphlet by Mercator, of the same year, Doctor Burbeck's lecture, a report from a committee of the board of admiralty in 1835, a report, in 1838, from a commission in Holland of experiments made in the dock yards of that kingdom. All these clearly show that the effects of Kyanizing are, the prevention of dry rot ; a more perfect and more certain seasoning of timber ; defence against the depredation of insects ; and that it can be applied to all kinds of timber. These are, certainly, correct results, if the authorities named are deserving of confidence, of which they undoubtedly are, in my opinion ; and therefore justify me in resting upon the single fact, that the process of Kyanizing is a certain mode of increasing the durability of timber.

The points which do not seem to be sufficiently determined, and upon which it would be extremely desirable to make a series of experiments, are :

- 1st. The proper strength of the solution for different kinds of timber ;
- 2d. The time required for it to penetrate different thicknesses of different kinds of timber ;
- 3d. The quantity absorbed by different kinds of timber, and the period of cutting best adapted to receive it.

In making these experiments, many interesting facts will be suggested to a careful observer, adding much to the value of the general results, probably the partial mineralization which the timber undergoes in the process, may render it also less liable to combustion.

In the report which occasioned the inquiry of the Senate, allusion is made to a process of mineralizing timber by the sulphates of iron and copper, as an invention of Doctor Edward Earle, of Philadelphia. I submit certain papers on the subject which Doctor Earle has left with me.

Very respectfully, sir, your obedient servant,

J. J. ABERT,
Colonel Top. Engineers.

HON. J. R. POINSETT,
Secretary of War.

PRESERVATION OF TIMBER.

HALL OF THE FRANKLIN INSTITUTE,
Philadelphia, December 12, 1839.

The committee on science and the arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic arts, to whom was referred for examination Dr. EDWARD EARLE'S method of preserving timber, report.

[The "report" being long, and a considerable portion of it, although a necessary part of the whole, being irrelevant to the main purpose; an abstract of it may suffice to show the proceedings of the committee, and the conclusions to which their investigations, experiments, and reasonings, have conducted them as to the nature and qualities of the means employed, and the probable advantages and value of the process. Composed of many of the most distinguished members of the Institute—such as President A. D. Bache, Messrs. Booth, Peale, Merrick, Frazer, and others, the above committee may be considered as constituting, in matters of science, the highest tribunal in our country; and the sanction of its approbation must go far to establish the character of those inventions and improvements on which it is conferred.

Having adverted to the form of the "process"—the materials used and the mode of applying them—together with the different kinds of decay to which timber is liable, and which they agree with others in attributing to the gaseous, albuminous, and glutinous substances inherent in it; they give a short history of the attempts which have been made, in different countries, to prevent or cure this costly evil. They then proceed to detail their own experiments made to determine the relative effects produced on the putrefactive constituents of timber, by the sulphates of iron and copper, and by corrosive sublimate, which salts they find to act in a similar manner and equally—and are considered as the materials most powerful in their preservative agency; and, also, their experiments to ascertain the introduction of the sulphates, by the proposed "process," into the body of different kinds of wood. In the course of the experiments made for these several purposes, they satisfy themselves of the following results, most affecting the subject, which we give in the language of the "report"]:

"1st. That if these salts—the sulphates of iron and copper—penetrate the wood thoroughly, according to the process adopted by Dr. Earle, we have an economical substitute for the mercurial compound—the corrosive sublimate;

"2d. That the solutions *are* carried through the pores of the wood, is conclusively shown by the experiments (detailed) on pieces taken from the interior of large pieces of timber which had been boiled with the solutions. The pieces were further split in half and the experiments made on the inner surface;

"3d. That heated solutions of various salts, such as corrosive sublimate and the sulphates of iron and copper, operate by expelling the gaseous matter, and rendering the albumen and gelatine inert in all the parts of the wood which they penetrate;

"4th. That they (the sulphates) penetrate different woods in different degrees; *ash* being more thoroughly impregnated; *hemlock* nearly the same; *hickory* less so; and *oak* still less;

"5th. That the sulphates of iron and copper produce the precipitation of albumen equally well with the perchloride of mercury (corrosive sublimate), and that of gluten in a nearly equal degree; and that they are therefore to be considered as an excellent and economical substitute for that compound;

"6th. That therefore the penetration of wood by these salts (the sulphates of iron and copper) renders it less subject to decay and the attacks of insects;

"7th. That although theory and experiment thus go to show the diminished destructibility of the wood, experiments on a large scale should be instituted in order to ascertain the correctness of these views of the committee, without which they are of little value; but that the subject is one of sufficient importance, and the probability of success sufficiently strong, to warrant the performance of such experiments with great care, and with less regard to the primary expense;

"8th. That lime penetrates wood in a similar manner"—but the opinion of the committee as to the effect of lime on the wood being less favorable, their experiments and reasonings are not thought important to be communicated.

To the report of the Franklin Institute it may not be unavailing to add that numerous other testimonials, consisting as well of facts as of the opinions of scientific and practical individuals, might be adduced by the patentee in favor of his "process;" and especially that the "committee on public highways"—after having used it to some extent in paving with blocks, during the summer and autumn of 1839,—have made a "report" on it to the councils consonant to that of the institute; presenting it in the most favorable manner to the attention of the councils whenever they shall consider it expedient to proceed further in the employment of wooden pavements, &c.

The process is conducted by means of boilers and wooden tanks, which, in size and cost, may be accommodated to timber of any dimensions and quantity, whether it be to prepare posts for fencing, or the largest ship-timber; and is capable of reducing it, in a few hours, from a perfectly green to a perfectly seasoned state. The efficiency of this method, it is believed, will prove equal, at least, to any that ever has been tried; while the facility with which it may be practised, and the trifling expense attending it, give it powerful claims to general acceptance. The materials employed being inexhaustible too, and not liable to fluctuation in price, can never occasion an augmentation of the cost.

Communications to the patentee, may be directed to the care of JNO. C. MONTGOMERY, Esq., President of the Little Schuylkill and Susquehannah Railroad Company, or to WM. RAWLE, Esq., Counsellor at Law, Philadelphia.

EDW. EARLE.

PHILADELPHIA, January 14, 1840.

PHILADELPHIA, October 4, 1839.

RESPECTED FRIEND—In compliance with thy request that we should communicate to thee the result of any experience we may have had in the

employment of wooden vessels in our copperas and blue vitriol works, we may briefly state that about two and a half years ago we had a number of large crystallizing vats made of seasoned white pine-planks into which the hot solution of sulphate of iron is drawn from the generators. The first effect observed was a shrinking of the wood and consequent leaking, to obviate which the crystallizers were successively buried, nearly to the top, in a moist clay soil. Several of those which have been thus buried have, from time to time, been taken up and examined, and we have found no indications of decay, the texture of the wood appearing generally quite firm and sound, except in places where there have been fissures into which the saturated solution penetrating has, by its crystallization, forced apart the fibres of the wood. We have no doubt that the impregnation of wood with the solution of copperas tends to its preservation, possibly in a high degree, but the facts above recited are all that have come under our notice. We formerly employed wooden vessels for the sulphate of copper, but finding that the wood was softened by the strong acid solution, we have substituted lead; we should, however, observe that that effect would not be produced by a dilute solution, such as that thou usest; on the contrary, we think it quite probable that in such proportion it may increase the efficiency of copperas in preserving the wood.

Respectfully,

CARTER & SCATTERGOOD,

Manufacturing Chemists.

Dr. E. EARLE.

Extract from the minutes of the committee on public highways, Philadelphia, August 13, 1839.

“*Resolved*, That this committee, having tried the process of Dr. Earle, are satisfied, from the effect of chemical tests on the split blocks and other evidence before them, that he has fully succeeded in impregnating the wood with the salts of iron and copper.”

WM. STEVENSON, *Secretary.*

The above “resolution,” in connexion with the fact that, under the authority of the said committee, several portions of the streets of Philadelphia have already been paved with blocks of wood prepared according to this process, and that the same work is still proceeding in other parts of the city, is strongly expressive of their confidence in the effect of it; and the letter of Messrs. Carter & Scattergood (a couple of our most respectable manufacturing chemists,) confirms, in a great degree, the fact recognised by the committee in their “report” to the councils forming a part of the annexed circular.

E. E.

PHILADELPHIA, *October 22, 1839.*

SIR: That you may be the better enabled to estimate the value of the “mineralizing process,” I respectfully submit to you the opinions and reasonings of a few of those who are of highest authority on such subjects. I ask the favour of your attention, therefore, to the following evidences of the

confidence to which that "process" is entitled, and to the great value and importance it must have for the uses for which it is designed.

I am, very respectfully, your obedient servant,

EDW. FARLE.

November 13, 1839.

In stating the reasons on which I have formed my mode of treating timber, for its preservation, and for believing in its efficacy, it may be most availing to show their agreement with the opinions of a few of the latest and most approved authors, who have either treated the subject professedly, or have stated the general principles and means, by which it and similar objects are to be attained. Of the first description, is Tredgold, whose authority on carpentry, the selection and employment of timber, &c., is generally received;—and of the latter description, is Dr. Ure, of Glasgow—one of the most profound, and certainly one of the most practical and extensively useful chemists, as regards the arts and manufacturers, now living. In speaking of the causes of disease in timber, and of the means of preventing and arresting it, Mr. Tredgold also gives a few admonitions of evils that occur in building, well deserving the attention of those who are in any way engaged in such undertakings. For such evils the "mineralizing process" seems to offer the best remedy.

Mr. Tredgold says—"warmth and moisture are the most active causes of decay."

"Building timber into new walls is often a cause of decay, as the lime and damp brickwork are active agents in producing putrefaction, particularly where the scrapings of roads are made use of instead of sand for mortar. Hence it is, that bond timbers, wall-plates, and the ends of girders, joists, and lintels, are so frequently found in a state of decay."

"However well timber may be seasoned [meaning in the ordinary way] if it be employed in a damp situation, decay is the certain consequence."

"It is generally imagined, that timber may be secured against the rot by impregnating it with substances that resist putrefaction."

"*Sulphate of iron* (green copperas) appears to be likely to answer this purpose."

"In the Swedish transactions, it is recommended for preserving the wood of wheel carriages from decay; (Newman, quoted by Chapman, on preservation of timber)—and Mr. Chapman observes, that *wooden vessels in which copperas is crystallized, become exceedingly hard, and not subject to decay.*"

To cure the *external* rot, the same author continues: "A solution of corrosive sublimate would answer very well. It was proposed by Sir Humphrey Davy. A weak solution does not produce the desired effect. Chapman says, there should be an ounce of corrosive sublimate to a gallon of water."

"*A solution of sulphate of copper makes an excellent wash; and is cheaper than the preceding one.*"

"*A strong solution of sulphate of iron is sometimes used, but is not so effectual as that of copper; and sometimes a mixture of the two solutions has been used.*"

Dr. Ure, describing the destructive process of vegetables, in his late very valuable work, expresses himself so pertinently to my purpose, and so forc-

bly inculcates the very principles and materials I had previously adopted, that I quote from him a few of his most significant sentences :

"In vegetables which putrefy, it is the *albumen* which first suffers decomposition. When dissolved in water, [as it always is, in its natural state] it very readily putrefies in a moderately warm air ; but when *coagulated*, it seems as little liable to putridity as fibrin itself. Hence, those means which by coagulation make the albumen insoluble, or form with it a new compound, which does not dissolve in water, but which resists putrefaction, are powerful antiseptics."

"In this way," acids, alcohol, salt, sugar, and a great variety of chemical substances, act in curing hides and meat, and in preserving, for domestic use, our summer fruits and vegetables, as sour kroust, &c. But, than all others, continues Dr. Ure, "the *metallic salts* operate still more effectually as antiseptics, because they form with albumen still more intimate combinations. Under this head we especially class the green and red sulphates of iron [the sulphate of copper] and corrosive sublimate. The latter, however, from its poisonous qualities, can be employed only on special occasions."

On a different occasion he says—

"Albumen occasions precipitates with the solutions of almost every metallic salt ; and, according to Dr. Bostock, a drop of saturated solution of corrosive sublimate, let fall into water containing one two-thousandth of albumen, occasions a milkiness and curdy precipitate." [In other places, Dr. Ure classes the sulphates of copper and iron by the side of corrosive sublimate ; and I have had occasion to show to the former "committee on public highways," that the solution of these sulphates, in the proportions in which I use them, produces, with albumen, the appearance here spoken of in precisely the same manner, and in an equally strong degree as the solution of corrosive sublimate.]

The expulsion of water and of oxygen gas, or the fixation of them by other substances, is another necessary means, stated by Dr. Ure, for the prevention of putrefaction :

"Even in those cases where no separation of the albumen takes place in a coagulated form, or as a solid precipitate, by the operation of a substance foreign to the juices, putrefaction cannot go on, any more than other kinds of fermentation, in bodies wholly or in a great measure deprived of their water."

This, and the expulsion of the gas, so necessary to putrefaction, "is most readily accomplished by *heat*, which, by expanding the air, evolves it in a great measure, and at the same time favors the fixation of the (remaining) oxygen in the extractive matter, so as to make it no longer available toward the putrefaction of the other substances."

From the above quotations, then, it appears, summarily, that *albumen* is the first subject of decay in timber ; and that the removal of it and the gases, is the surest means of preventing that decay. It evidently appears, also, that the most certain method of accomplishing this is by the employment of corrosive sublimate, or of the *sulphates of iron and copper with heat*. Now, such are the very means I employ ; having ascertained for myself, by many experiments, the *proportions* in which those salts may be employed with most efficacy and advantage. I confidently, therefore, refer to Mr. Tredgold and Dr. Ure, to say nothing of others, for sanction of the principles and practice I had already adopted in my "mineralizing process,"—

which is, therefore, believed to present all the certainty that can belong to any method for giving to timber the permanent usefulness of which we are in search.

EDW. EARLE.

November 12, 1839.

SPECIFICATION OR DIRECTIONS FOR MAKING USE OF THE ABOVE PATENTS.

For the use of Patent No. 2.

The timber being placed, and properly confined in its position, in a strong wooden tank, a solution of the sulphates of iron and copper is to be added to it in sufficient quantity to cover it several inches. This should be done in the evening, and, the following morning, the temperature of the fluid should be very gradually raised to the boiling point, and steadily kept up from two or three to six or eight hours, according to the size and kind of timber;—very large sticks—especially if they be of dense, hard wood—requiring longer treatment than those of moderate size, or of more open and pervious quality. After the boiling has been continued the proper time, the timber is to remain in the fluid to cool gradually; then to be removed to a shed, and laid on its side so as to be freely ventilated on all sides, yet protected from high wind, from cold, and from the sun, until it is thoroughly dry. The whole process is to be facilitated by a perforation, of a moderate caliber, through the centre of the timber (when the size, and convenience, admit of it) prior to the boiling; and, in that case, when it is dry (which, in temperate weather, it will soon be) and before it is used the perforation is to be tightly plugged with wood of the same kind, and which has been treated in the same manner. The solution may be made in the proportions of one-fourth of the sulphate of copper and three-fourths of the sulphate of iron—that is, a pound of the first and three pounds of the latter—to twelve gallons of water; and it should be in sufficient quantity to keep the timber constantly submerged. Also, an additional quantity of solution, but of only half the strength of the first, should be prepared and added occasionally to repair the waste of absorption and evaporation during the process: and it should be added hot, that it may not check the boiling. In purchasing these salts it is important to select such as are free from superabundant acid, and from oxydation.*

For the use of Patent No. 1.

When it is preferred to prepare timber with lime instead of the above salts, the process is to be conducted in precisely the same way. The lime-water, however, should be the strongest that can be made, viz, by adding a peck of best quicklime to every two hundred gallons of water, carefully mixing them, that every portion of the lime may be slaked, and the water be fully saturated. An extra quantity of the same mixture, also, should be

* In using these salts it must be remembered that no iron vessel, nor iron nails for fastenings or other purposes, are to be brought into contact with the solution. Copper and lead are the only metals that may be so employed.

prepared and occasionally added during the operation, to maintain the strength of the fluid, as well as to repair the waste by absorption and evaporation. The boiling being finished, the timber is to undergo the same treatment as above. The most soluble lime, or what is known under the name of *fat lime*, should be preferred.

EDW. EARLE.

APRIL 12, 1839.

DIAGRAPH OF APPARATUS, No. 1.

For mineralizing timber. E. Earle, patentee, Philadelphia.

Figures 1 and 2 exhibit a front and a lateral or sectional view of the furnace, boiler, &c.

FIG. 1.

- AA.—The sides of the wall, 12 to 15 inches thick, rising and surrounding the boiler as high as the water-line. The front part of the wall, in contact with the boiler, is supposed to be removed to show the manner in which it curves round the boiler at the distance of two or three inches, and allows it, in its whole length, to be enveloped in the fire.
- B.—The fireplace and iron door.
- C.—The ash pit.
- D.—The front end of the boiler, supported by a strong iron bar extending across from one side-wall to the other, and forming the top of the fireplace.
- E.—The man hole, 15 inches diameter, to admit a man to the interior of the boiler to clean it.
- F.—The cock or valve through which water is admitted from the receiver.
- f.—The gauge-valves; one on and one above and below the water-line.
- G.—The drum-head, or reservoir of steam, 30 inches long and 8 inches diameter, rising from the boiler by a neck of 4 inches diameter and 6 inches high, and having a number of pipe-ends soldered into it for attachment.

FIG. 2.

- A.—The fire-grate, $4\frac{1}{2}$ feet long to transverse wall, G; 24 inches wide, and 15 inches deep from the boiler to the grate.
- B.—The ash-pit through which the fire is maintained by atmospheric air.
- C.—The flue, $4\frac{1}{2}$ inches vertical, by 12 or 15 inches horizontal, and 30 inches wide, formed between the boiler and top of the transverse wall.
- D.—Shows a large hollow space (the side wall being removed) extending from the transverse wall to the chimney, and allowing the expansion of the heat around the body of the boiler.
- EE.—The flue, 4 inches vertical by 9 wide, leading into the chimney under the boiler, which rests on a brick column 12 inches square, at figure 1, near the end. The continuation of the flue forms the funnel of the chimney, which should be round and smooth inside, and about 9 inches in diameter.
- F.—The chimney, 12 to 15 feet high, with a damper at figure 3, to prevent the too rapid escape of heat.

- G.—The transverse wall, 12 to 15 inches thick, extending across the interior of the furnace from one side wall to the other—supporting the inner end of the grate, and forming the flue, C, between its top and the boiler. It has an iron door in the under part (which should fit very tight) to allow of cleaning out the interior of the furnace.
- HH.—The water-line of the boiler, should be about *two-thirds* the perpendicular diameter.
- K.—The safety-valve, 4 inches diameter.
- L.—The gauge-pipes, one on and one above and below the water-line.
- M.—The valve-cock; to be connected by a pipe with the discharging pipe, M, of the force-pump.

FIG. 3.

Another view of the boiler, connected by a pipe and flanges, of 2 inches diameter, with the reservoir-pipe, A.—A stop-cock at figure 2, to turn off the steam when required.

FIG. 4.

- A ground-view of the tank, which is supposed to be 30 feet long, 6 feet wide, and 6 feet deep; solid contents 1,080 cubic feet. It should be made of the best three-inch seasoned plank, and so constructed as to be secure against leaking and bursting
- A.—The large reservoir-pipe, of 6 inches diameter, lying across the bottom of the tank, and having 18 pipes, of two-inch diameter, soldered into and extending to the other end, where they are attached to another pipe.*
- B.—A pipe of 3 inches diameter, which conveys the condensed steam to the receiver.
- C.—The castiron receiver, 12 inches square and 18 inches deep, into which the condensed steam is discharged.
- D.—A cock, which should be a foot from the bottom of the receiver, to be connected, by a short pipe, with the suction-valve of the force-pump.
- E.—The cock which discharges the solution from the tank when no longer fit for use.

FIG. 5.

- Farnam's double force-pump, which discharges both by the upward and downward stroke. It should be made of brass instead of iron, and the valves should be of the same metal instead of leather.
- A.—The piston.
- D.—The suction-pipe to be connected with the cock, D, of the receiver.

* If it should be found difficult to make the necessary connexions of the pipes with *hard* solder, another, and, perhaps, better method may be substituted, to have the reservoir-pipe, A, cast of brass, one-fourth of an inch thick, with bosses, in which female screws may be formed to receive the male screws of the correspondent longitudinal pipes; the other end of which may be attached by coupling-boxes to short pipes, three or four inches long, proceeding from the other cross-pipe, B, cast of brass for the purpose, and discharging the condensed steam into the reservoir, C.

M.—The discharging-pipe to be connected with the cock, M, in the end of the boiler. For convenience sake, the connxtions of the pipes in the tank, and of the force-pump with the boiler, should be the reverse of the representation by the figure, that the receiver and pump may be near the front end of the boiler.

DIAGRAPH OF APPARATUS, No. 2.

FIG. 1.

- A.—The front of the furnace.
 B.—The boiler, 78 inches high (exclusive of the man-hole, D, covered by a cap), and 20 inches diameter, made of substantial copper, with an appropriate thick bottom.
 C.—The convexity of the bottom of the boiler, like the bottom of a bottle.
 D.—The man-hole, 15 inches diameter, to admit a person, to clean the boiler when necessary.
 EE.—The wall of the furnace.
 F.—The iron door, above which a very thick iron plate, or strong bars, are worked into and across the front wall to support the incumbent weight of the upper part of it,
 G.—The ash-pit, through which the atmospheric air has access to the fire.
 H.—The bottom-pipe conveying the colder fluid *from the tank into the boiler*. The construction and dimensions of this and the other pipes must be accurately observed. The whole length of the lower pipes is 60 inches, or 5 feet, viz:

	inches.
From the inside of the tank, to which it is attached by a flange, or broad expansion, of $2\frac{1}{2}$ or 3 inches, and fastened by strong copper nails to the outside of the tank - -	3
From outside of the tank to the first brass flange connecting it with the cock - - - - -	29
Thickness of said flange and the correspondent flange of the cock - - - - -	1
Length of the stop-cock from flange to flange - - - - -	8
Thickness of the two other flanges connecting the cock with that part of the pipe which proceeds from the boiler - -	1
Length of the pipe from cock to the wall 3 inches, and thence to the interior of the wall 12 - - - - -	15
Length from interior of the wall through the space forming the flue, between it and the boiler, to which it is riveted on the inside - - - - -	3
	—60
Diameter, where it issues from the tank, gradually lessening to where it joins the cock - - - - -	6
Small diameter, from where it joins the cock to the boiler - -	2

H.—The upper pipe, proceeding *from the boiler to the tank*, the lower side of which is 24 inches above the upper side of the lower pipe, has the same diameters, and differs in length only, viz:

From the boiler to where it joins the cock (three inches beyond the outside of the wall) - - - - -	18
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Flanges and cock as above - - - - -	10
From cock to tank, and through tank, to which it is united as above - - - - -	17

FIG. 2.

- A.—Front view of the tanks, six inches from the furnace at their tops, showing their proportions in width at top and bottom, the first being 9 and the last 3 feet ; and the trusses, *a, a*, which are connected with the outside frame for supporting the loaded tank. The length of the tank is 21 feet at top and 18 at bottom. The inclination of the sides, therefore, is 3 feet, and of the ends 18 inches. Depth 6 feet. Cubic contents 526½ feet.
- C.—Exhibits the fall of the top, which lifts by a hinge 18 inches from the outer edge of the tank. That it may be easily raised, it should be divided in its length into several sections, and one edge should overlap the other to keep the tank tight and prevent evaporation.
- D.—The water-line, intended to be 6 inches below the top.

FIG. 3.

- AA.—The boilers, *two* being required for tanks of this size.
- BB.—The brick work of the furnace, 12 inches thick. Both together show the interval or flue of 3 inches between them.
- CC.—The tanks—showing their interior.
- DD.—The lower pipes.
- EE.—The upper pipes.
- F.—The horizontal wall running off on a level with the top of the furnace, forming an oblong square of 18 or 20 inches diameter, and enclosing
- G.—The horizontal flue, six by nine inches, which, entering the chimney, forms the bottom of the funnel.
- HH.—The chimney, 18 or 20 inches square, and about 12 feet high. It should be coated with mortar very smoothly within.
- I.—The funnel of the chimney about nine inches square.

FIG. 4.

- A side-view of the strong framework holding the tank, to which the trusses, *a, a* (Fig. 2), are firmly joined.

FIG. 5.

An interior and ground-view of the furnace, flue, &c.

- A.—The fire grate, extending from the front of the wall to two thirds of the diameter of the boiler, or 28 inches. The fireplace proper, commences where the edge of the boiler rests on the brick-work, or at the front edge of the flue, and the fire should not be kindled nor suffered to burn within 12 inches of the door. It is 15 inches vertical, nine inches wide, and nine inches high on the sides, where it slopes off and gradually rises six inches more to where the edge of the boiler rests on the foundation brickwork all round, as represented by the shaded part, except at D.

- B.—The enclosing wall of the furnace, 12 inches thick.
- C.—The flue or space between the interior of the wall and the boiler, three inches, extending up to the water-line.
- D.—The draught from the fire into the flue. It is represented by three courses of brick, as bounding the fireplace and commencing the draught, which forms an angle, and, traversing the remaining third of the bottom of the boiler, enters the flue on one side of the middle line of the furnace and boiler.
- E.—The partition, one brick or four inches wide, which, commencing with the commencement of the flue, obliquely crosses the middle line as it rises to the top of the furnace. This compels the heat and smoke, entering the flue at D, to make a spiral ascent round the boiler as they rise to escape at the horizontal flue and pass off to the chimney.
- FF.—The boiler.
- G.—The opening of the horizontal flue, nine inches vertical and six inches wide, leading to the chimney.
- H.—The water-line of the boiler, leaving six inches above it, beside the cap, as space for ebullition.

FIG. 6.

A sectional view showing the form of the pipes as they convey the solution from the bottom of the tank to the bottom of the boiler, and return it from the upper part of the boiler to the upper part of the tank; the body of the pipe; the flange of the large end of the pipe, to be fastened by strong copper nails to the inside of the tank; the flange of the small end of the pipe, embraced between the brass flange and the correspondent flange of the cock, where they are united by screws. To prevent leaking at *this and all similar junctions*, a piece of pasteboard, or coarse thick cloth, with a circular hole equal to the diameter of the pipe and cock, and well charged with white lead, should be interposed between the flanges.

FIG. 7.

Represents the brass flange. A very broad and strong one should be laid on the copper flange of each pipe where it attaches to the inside of the tank, and well secured by strong brass screws, to prevent the pipe from tearing loose from the wood.

GENERAL DIRECTIONS.

The boilers of diagraph, No. 2, are to be of copper, and no metal, except copper, brass, or lead, is to be employed for any purpose within the tanks, as the solution of the sulphates would destroy any other.

The furnaces and boilers are to be first adjusted and permanently fixed, and the position of the tanks is next to be accommodated to them.

In the construction of the tanks, long copper rods, of three fourths of an inch diameter, with a broad head at one end, and a screw and nut at the other, should perforate the planks crosswise of the grain and the joints; by which the planks may be drawn closely together when they have shrunk, and thus be prevented from leaking. They are necessary, also, to strengthen the tank.

These directions apply to diagraph, No. 1, also, except that the *boiler*, as it does not come into contact with the solution, had better be of iron.

Each of the boilers, of diagraph, No. 2, must be provided with a pipe and cock similar, in *size and form*, to the *upper pipes* which convey the solution from the boiler to the tank, and long enough to pass through the wall, say eighteen inches. These are to be attached to the bottoms of the boilers (one to each) immediately opposite to the door of the furnace. They are intended to let off the solution from the boilers when no longer fit for use. These pipes and cocks are not exhibited in the engraving, as they are supposed to be under, and concealed by the horizontal wall connecting the two furnaces.

Each tank, also, should be provided with a *large cock* for letting off the exhausted solution; and with a *small common cock*, inserted at the bottom and outer side of each tank, for ascertaining, occasionally, the heat of the solution.

✂ A strong wooden grate, or frame of cross bars, should rest on pieces, as shoulders, fastened to the bottom of each tank, and rising just above the level of the pipes, to prevent their being pressed by the timber with which the tank is loaded; and for the purpose, also, of allowing the lower stratum of the solution to flow freely into the pipes (of diagraph, No. 2), conducting it to the boiler. A separation, two or three inches, of the timbers, where the *upper pipes* enter the tank, should be left for free transmission of the *heated* solution across the width of the tank at this part. It might be well assisted by attaching an additional copper pipe to the entrance of the other to conduct the solution, that thus it might be discharged about the middle of the tank, and the *heated* solution equally diffused.

ENGINEER DEPARTMENT,
Washington, April 7, 1840.

SIR: In answer to the resolution of the Senate dated March 20, asking for certain information on the process of "Kyanizing," I have the honor to report, that this process has been applied to the preservation of the timber used at two of the public works under this department, the officers in charge of which were furnished with a copy of the resolution, and directed to supply all the information in their possession on the subject.

Copies of their communications are submitted herewith: they embody all the information the department is enabled to offer from its own experience.

I am, sir, very respectfully, your obedient servant,

JOS. G. TOTTEN,
Colonel, and Chief Engineer.

HON. J. R. POINSETT,
Secretary of War.

WASHINGTON, March 27, 1840.

SIR: The following information, relative to Kyanizing timber to prevent the dry-rot, is, at your request, herewith communicated to the department.

As it was necessary to Kyanize all the timber used in repairing Fort Niagara when operations commenced, the proper steps were taken for putting into practice Kyan's method. This required nothing more than a water-tight vessel, without any iron on its inside, and a quantity of corrosive sublimate. The sublimate was dissolved in hot water, the timber to be saturated placed in the vessel, and the solution poured therein. It was left in this state a certain number of days, depending on the size of the timber. The solution was then pumped out, and the timber taken from the tank and placed under cover to dry.

The vessels used by me in my operations were, first, a tank, made of four-and-a-half inch Canadian pine-plank, thirty feet long, eight wide, and five and a half deep; and, secondly, a cistern of a capacity about one-third that of the tank. The plank were tongued and grooved, and secured together by one-inch iron bolts. In most cases, it would be well to calk the vessels on the inside; but, as mine did not leak on being filled with water, no precaution of this kind with them seemed necessary. The corrosive sublimate was dissolved in hot water and poured into the cistern, and, after a sufficient quantity had been used, water was added, until the strength of the solution indicated a proportion of one pound of corrosive sublimate to fifteen gallons of water. The tank, in the meantime, was filled with timber, well fastened down with cleats, with sufficient space between the different sticks to allow a free circulation of water around them; the solution was then pumped from the cistern into the tank, and, after having been left therein the requisite number of days, was pumped back into the cistern: the timber was then taken out and placed under shelter to dry; and this completed the whole operation.

The same solution can be used any number of times, provided care be taken to add, occasionally, a sufficient quantity of corrosive sublimate to keep it at its proper degree of strength.

The timber saturated by me, amounting altogether to between three and four thousand cubic feet, is mostly of a large size, the different sticks varying between eight and twenty four feet in length, and twelve and eighteen inches in breadth, and has cost a little over twelve cents a cubic foot. This, however, should not be taken as the average cost; for, beside the large size of the timber saturated, the circumstances under which the operation has thus far been conducted have been by no means favorable. The tank was not completed until nearly the 1st of November; so that most of the timber prepared has been Kyanized during the winter months—the season of the year, of all others, least favorable for such an operation. Why it is so, a few words will explain. When the weather was cold, the time required for loading and unloading the tank was much longer than when moderate, and hence the cost was greater. Besides, the moisture in the timber during the severe weather being frozen, the moment a stick was placed in the solution it became enveloped in a thick crust of ice. This, if not removed, would have prevented the corrosive sublimate from having any action whatever upon the wood; and therefore it became necessary, in order to avoid delaying the work, to incur the expense of melting the ice thus formed around the different sticks, and of preventing the solution afterward from freezing.

The timber, after it has been prepared, is found to be a little darker in its appearance.

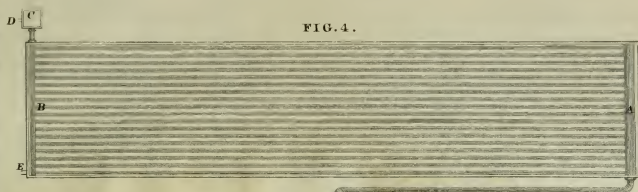
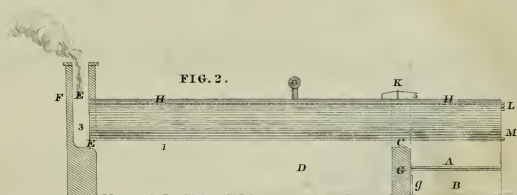
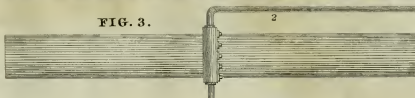


FIG. 3.



Scale of Feet

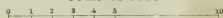
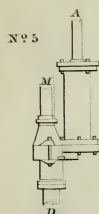
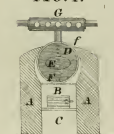


FIG. 1.



DIAGRAPH
Nº 1 OF
APPARATUS
FOR
MINERALIZING
TIMBER

E. Earle, Patentee
Philad^a 1839.

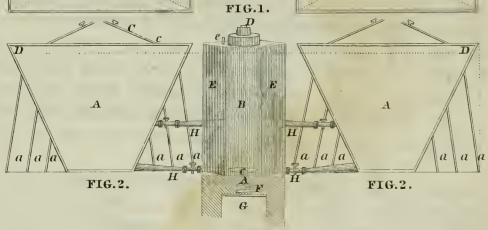
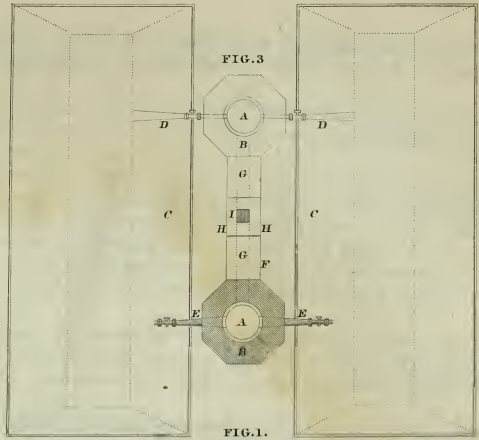
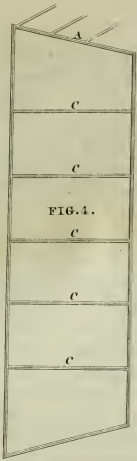


FIG. 5.



FIG. 7.



FIG. 6.

DIAGRAPH
N^o 2 OF
APPARATUS
FOR
MINERALIZING
TIMBER

E. Earle Patentee
Philad.^a 1839

The very short time the process of Kyanizing at Fort Niagara has been in operation renders it impossible to decide definitively either on its efficacy or cost.

From an article in the first volume of the Transactions of the Royal Engineers, considerable information on the subject can be obtained, and from this the following remarks were taken.

Professor Faraday states, in a lecture of his on the subject, that, in his opinion, the efficacy of the process consists in a chemical combination being formed between the albuminous principle of the wood, which is first liable to decay, and the corrosive sublimate; and Dr. Birkbeck says it produces the same change in vegetable substances that tanning does in animal.

They both express the opinion that there can be no doubt of the entire success of the experiments.

From a number of trials mentioned in the same article, it would seem that the preparation of timber in this manner has the effect of slightly reducing its specific gravity, and making it stiffer, but at the same time more brittle.

To ascertain whether the timber has been sufficiently saturated, Professor Faraday recommends the application of the hydro-sulphuret of ammonia, which turns black when it touches mercury. By this means, its presence was discovered in a cube of elm, to the depth of from one-fifth to one-fourth of an inch, and, by voltaic action, from three-fourths to one inch. Its action was less perceptible at the same depths in a cube of oak, and still less so in one of fir—the turpentine in the last preventing, probably, the penetration of the solution.

He likewise says, the success of the method is rendered the more certain from the tendency of the solution to distribute itself (though at first saturating but to a small depth) equally through all the pores of the wood; and, even if it did not strike entirely through the heart of it, by forming a chemical combination with its albuminous principle to the depth of an inch, it would necessarily retard for a long time the action of the dry rot. This will readily be admitted, when it is considered that the mere charring a stick will make it last much longer.

The following extract is taken from a letter of Colonel Harding, of the royal engineers, to Colonel Sir John May, K. C. B., of the royal carriage department:

“Placed in contact with, and under the flooring of, the old Cadet Hall, which is much affected by dry rot, prepared with Kyan’s patent—

- 1 piece of oak of 24 inches, 3 by 3,
- 1 piece of ash of 24 inches, 3 by 3,
- 1 piece of elm of 24 inches, 3 by 3,
- 3 pieces of memel fir of 23 inches, 4 by 2,
- 3 pieces American fir of 23 inches, 4 by 2,
- 1 piece white rope of 5 inches,
- 1 piece white rope of $2\frac{1}{2}$ inches,
- 1 piece white rope of $1\frac{1}{4}$ inches,
- 1 piece tent line or cord,
- 4 pieces canvass,

with duplicates of exactly similar materials unprepared.

“We found all the cordage and canvass that were unprepared had become more or less rotten, except a piece of canvass; but no material alteration in the wood, except in one piece of memel and one of American un-

prepared, which, with its fellow piece, prepared, was taken up, as it appeared they had both become injured by the dry rot." The others were left under the floor. When examined, they had been in this position eighteen months.

"We then had the following pulled up out of the ground, into which they had been driven 15 inches, and the tops exposed to the south sun and to the drip, &c., under the eaves of a building, prepared with Kyan's patent :

- 1 piece of oak, 24 inches, 3 by 3,
- 1 piece of ash, 24 inches, 3 by 3,
- 1 piece of elm, 24 inches, 3 by 3,
- 1 piece memel fir, 23 inches, 4 by 2,
- 1 piece American fir, 23 inches, 4 by 2,

and exactly similar pieces of the same unprepared.

"This trial appeared to have had more effect on the wood than the preceding one at the Cadet Hall;" the unprepared elm being very defective, while the prepared remained perfectly sound.

At the expiration of three years from the time they were first put down, another examination was made by Colonel Harding. He states, on the wood placed under the flooring of Cadet Hall no material effect was produced, but the cordage and canvass unprepared had become rotten, while that prepared still remained sound. As for the others, driven into the ground under the eaves of the building, with their tops exposed to the sun, the prepared were in a perfectly sound state, but, of that unprepared, a portion was much decayed, and all more or less affected.

In the article from which these facts are taken it is also mentioned, that a vessel, the timber of which was prepared with Kyan's patent, returned home, after a twenty-nine-month voyage, as sound as she was the day she started. The crew enjoyed good health during the whole time, and the bilge-water did not seem affected by the corrosive sublimate.

A bolt, much corroded, was examined to ascertain whether it had been injured by the mercury, but Professor Faraday could not discover the presence of any.

Trials have been made by Mr. Kyd, of Calcutta, to find out whether the preparation of timber, after Kyan's method, would not prevent it from being attacked by the white ant, so destructive to timber between the tropics, and he seems to be of the opinion that it will.

That the Kyanizing of timber used in the construction of works, alternately exposed to the action of the sun and fresh water, might be introduced with much advantage to them, can scarcely admit of doubt; but whether it would prove beneficial for those in salt water is not quite certain, though the case of the vessel before mentioned is somewhat in its favor.

The anti-dry rot company of London, Kyanize timber at the rate of 20 shillings sterling for every 50 cubic feet; but, though the cost of corrosive sublimate is greater in this country than in Great Britain, I am satisfied that timber can be prepared at a cheaper rate.

I have the honor to be, very respectfully, your obedient servant,
WILLIAM D. FRASER,
Captain Engineers.

Col. J. G. TOTTEN,
Chief Engineer, Washington.

ENGINEER OFFICE, FORT ONTARIO,
Oswego, N. Y., March 29, 1840.

SIR: I have the honor to acknowledge the receipt of your communication of the 24th instant, enclosing a copy of a resolution of the Senate, dated March 20, and asking for such information as I may possess on the subject of Kyanizing timber, and particularly with reference to its cost.

The Kyanizing process was commenced here about the first of October last, and, consequently, no opinion as to the efficacy of the preparation, in protecting timber from dry rot and the worm, can yet be formed. The operation has been conducted under the disadvantages incident to every untried experiment, and has not been sufficiently extended in time to give, with accuracy, the data from which to determine the expense.

One tank only has yet been built, and of the following dimensions: thirty feet long, sixteen feet wide, and four and a half feet deep. This tank will ordinarily contain 1,535 cubic feet of timber. The quantity of solution required to immerse it, has been 4,000 gallons; and at the rate of one pound of corrosive sublimate to fifteen gallons of water, 244.4 pounds corrosive must be dissolved for this purpose. According to Mr. Kyan, the abovementioned quantity of timber should imbibe 38.3 pounds corrosive sublimate; and, consequently, on or previous to the removal of this timber from the tank, and the substitution of a fresh charge, equal to the first in quantity, 38.3 pounds corrosive sublimate should be added to the solution. This being added in the smallest quantity of water which will dissolve it, seems amply sufficient for restoring the strength of the whole. The cost of charging the tank with 1,535 cubic feet of timber, and of removing and placing it under a timber-shed when Kyanized, has been, in the case of large timber 18 × 18 inches, and from 20 to 29 feet long, \$25. The price of corrosive sublimate in New York is \$1 35 per pound, and fifty cents per pound additional is paid for the use of the patent. The cost of transportation from New York to this place has been, during the last season, 90 cents per hundred.

With these data, and excluding the cost of the tank, cistern, and crane, for moving the large timber, the Kyanizing costs at the rate of 6 cents $2\frac{6}{10}$ mills per cubic foot.

The tank, with its cistern, cost \$495 84, and the crane \$79 30. The cost of the tank was considerable greater than would now be necessary. It is proposed to construct an additional one, somewhat larger than the first, and as the crane and cistern already built will serve both tanks, it is expected that the one proposed can be built for about \$300. The quantity of timber required in the rebuilding of the fort, is estimated at 91,812 cubic feet.

Charging the cost of the two tanks, one cistern, and one crane, in the expense of Kyanizing the abovementioned quantity of timber, it will increase by $9\frac{4}{10}$ mills the cost of Kyanizing a cubic foot; so that the expense of Kyanizing, including the necessary machinery, and supposing this machinery to be of no value afterward, will not, in this case, exceed 7 cents and 2 mills per cubic foot. This, it will be observed, is about equal to the first cost of sawed timber at this place.

Sheds, in proportion to the quantity of Kyanized timber on hand at any one time, are necessary to protect it from the weather until dried. But, as this protection costs but little more than the materials for its construction, and these can afterward be appropriated to other use, this item will not

appreciably increase the expense. Some of the solution must remain on hand at the close of operations, but it is presumed that this, as well as the tanks, &c., might be disposed of to private individuals.

I have observed, during the autumn and winter, that the solution freezes with nearly the same facility as water; that the ice thus formed contains little or none of the corrosive sublimate, while the strength of the unfrozen liquid is proportionably increased. The details of the process, and the time during which the timber is immersed, are in conformity with the "directions" published by Mr. Kyan's agents, a copy of which I presume is in your possession.

Respectfully submitted by, sir, your obedient servant,

D. LEADBETTER,
Lieutenant Engineers.

[Colonel JOSEPH G. TOTTEN,
Chief Engineer, Washington.